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(54) **FILLING HEAD FOR FILLING A TANK WITH A LIQUID**

(71) Applicant: **AKWEL SA**, Champfromier (FR)

(72) Inventors: **Didier Comtat**, Monteux (FR); **Lionel Joly**, Lirac (FR); **Antoine Marier**, Sorgues (FR); **Santiago Andrade Calvo**, Galicia (ES)

(73) Assignee: **AKWEL SA**, Champfromier (FR)

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See application file for complete search history.

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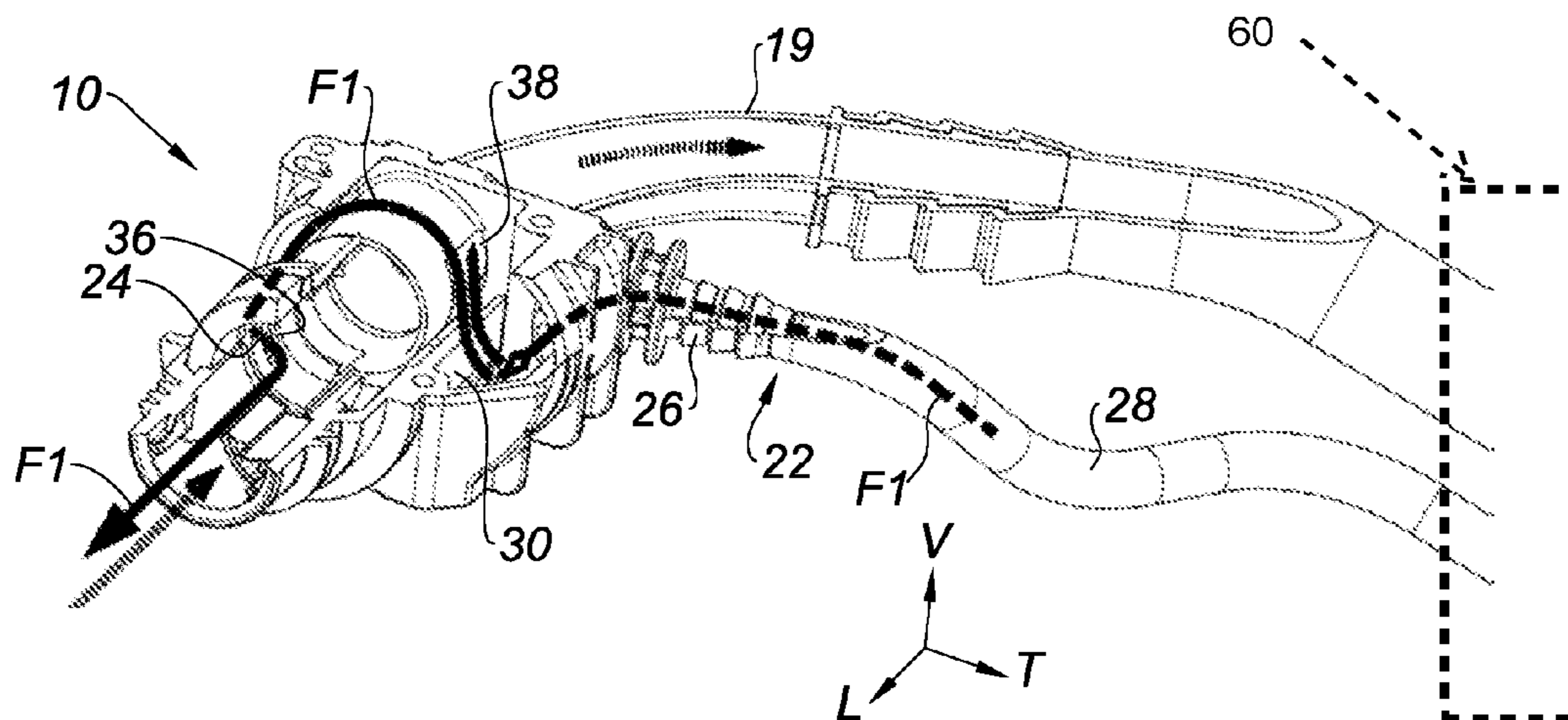
Primary Examiner — Nicolas A Arnett

(74) *Attorney, Agent, or Firm* — Oliff PLC

(57) **ABSTRACT**

A filling head for filling a tank with a liquid, the filling head delimiting a conduit for filling the tank which extends axially along a filling axis from an upstream section which is adapted to receive a filling nozzle, up to a downstream section which is designed to be connected on the tank to fill, and a degassing circuit including an inlet which is adapted to be connected on the tank and an outlet in communication with the outside, the filling head being characterized in that it delimits a suction window which connects the downstream section of the filling conduit on the degassing circuit, so as to promote the suction of the gases via the degassing circuit, during the filling of the tank.

11 Claims, 2 Drawing Sheets



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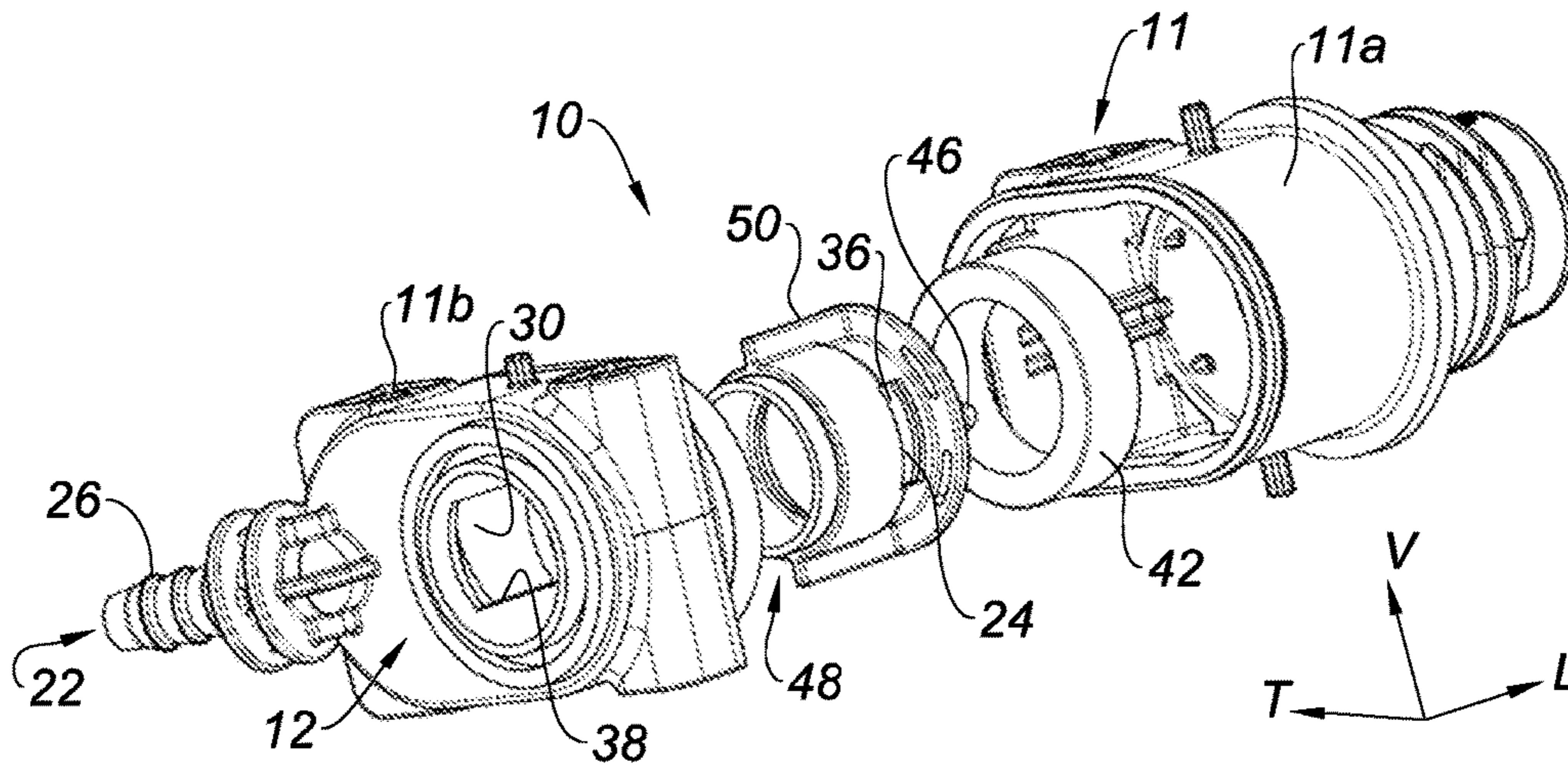


Fig. 1

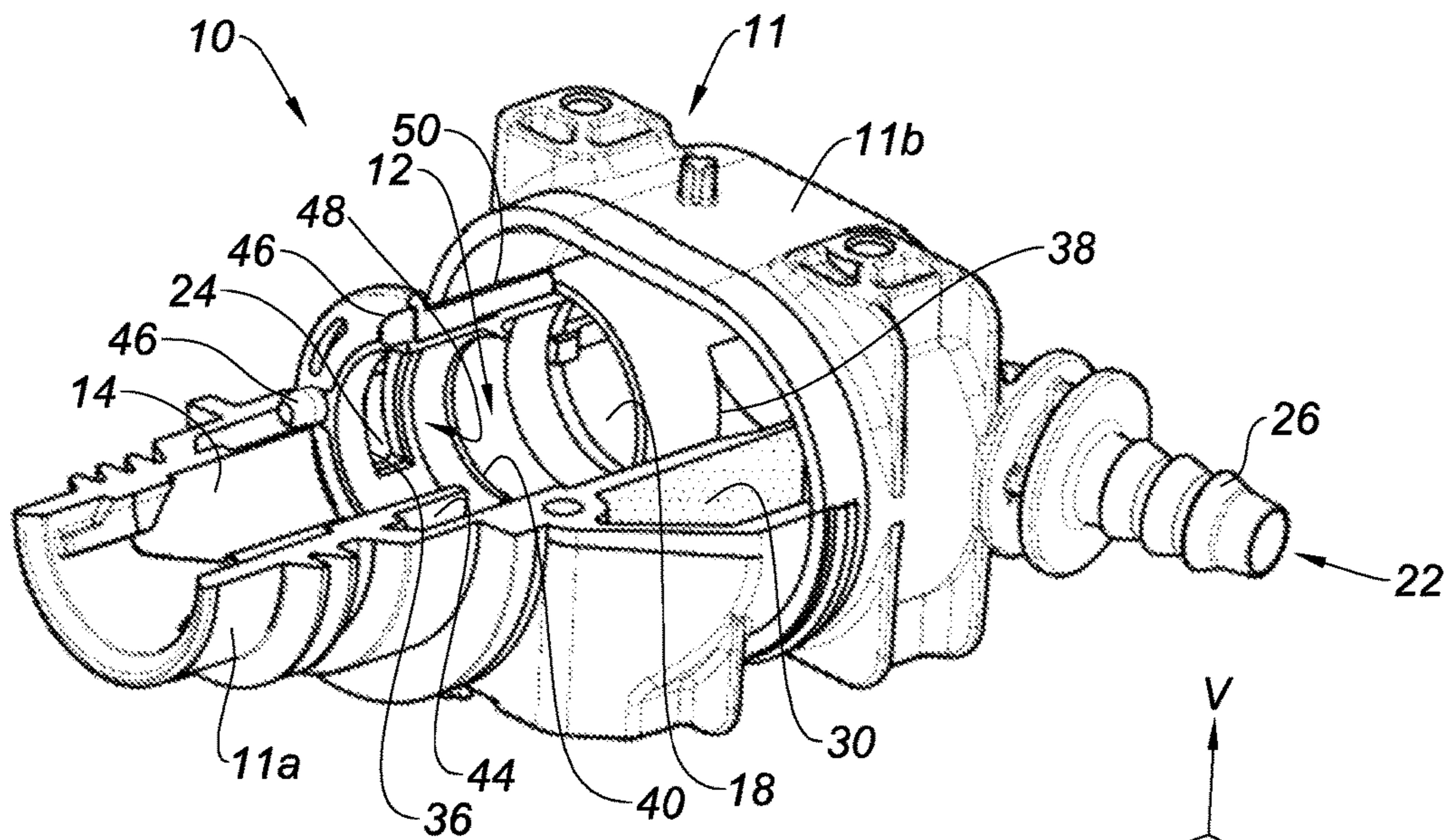


Fig. 2

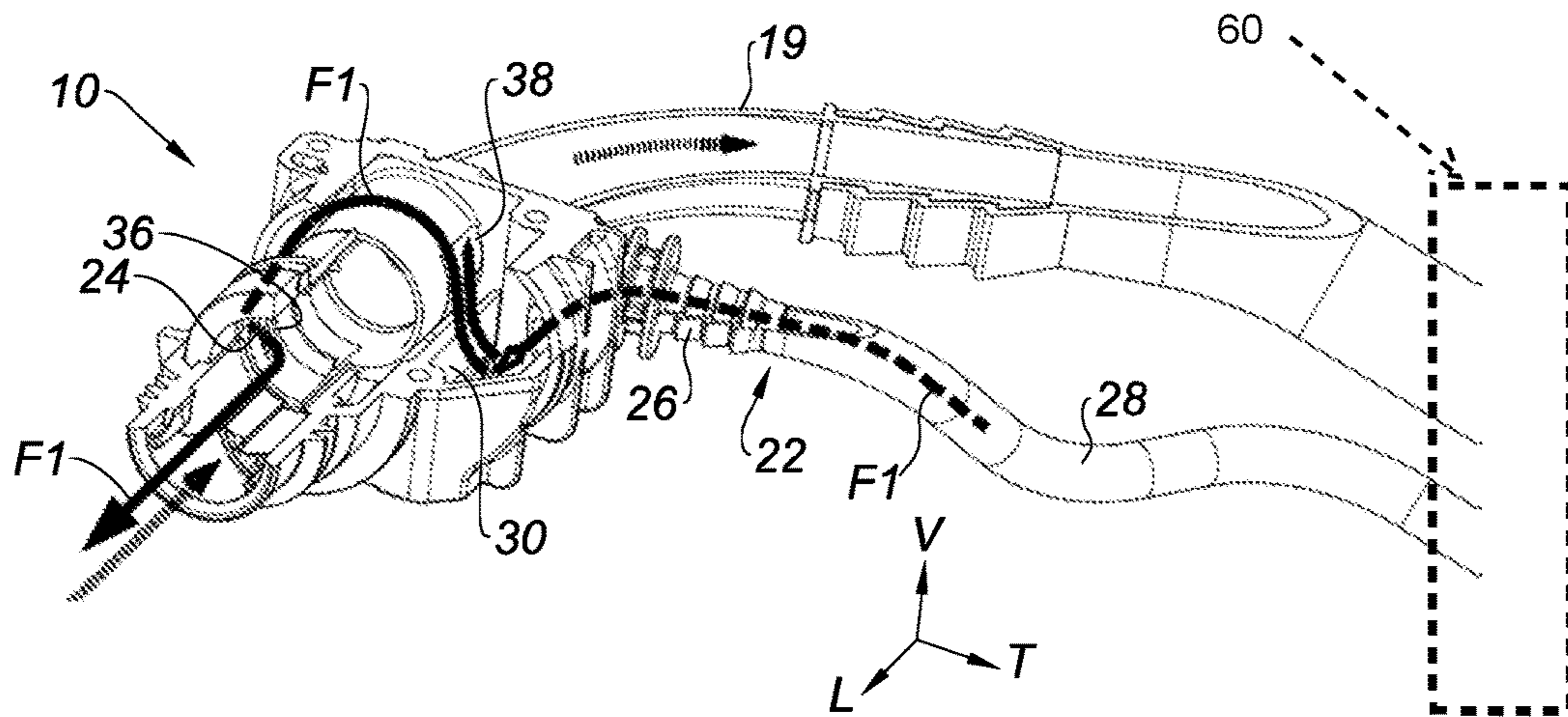


Fig. 3

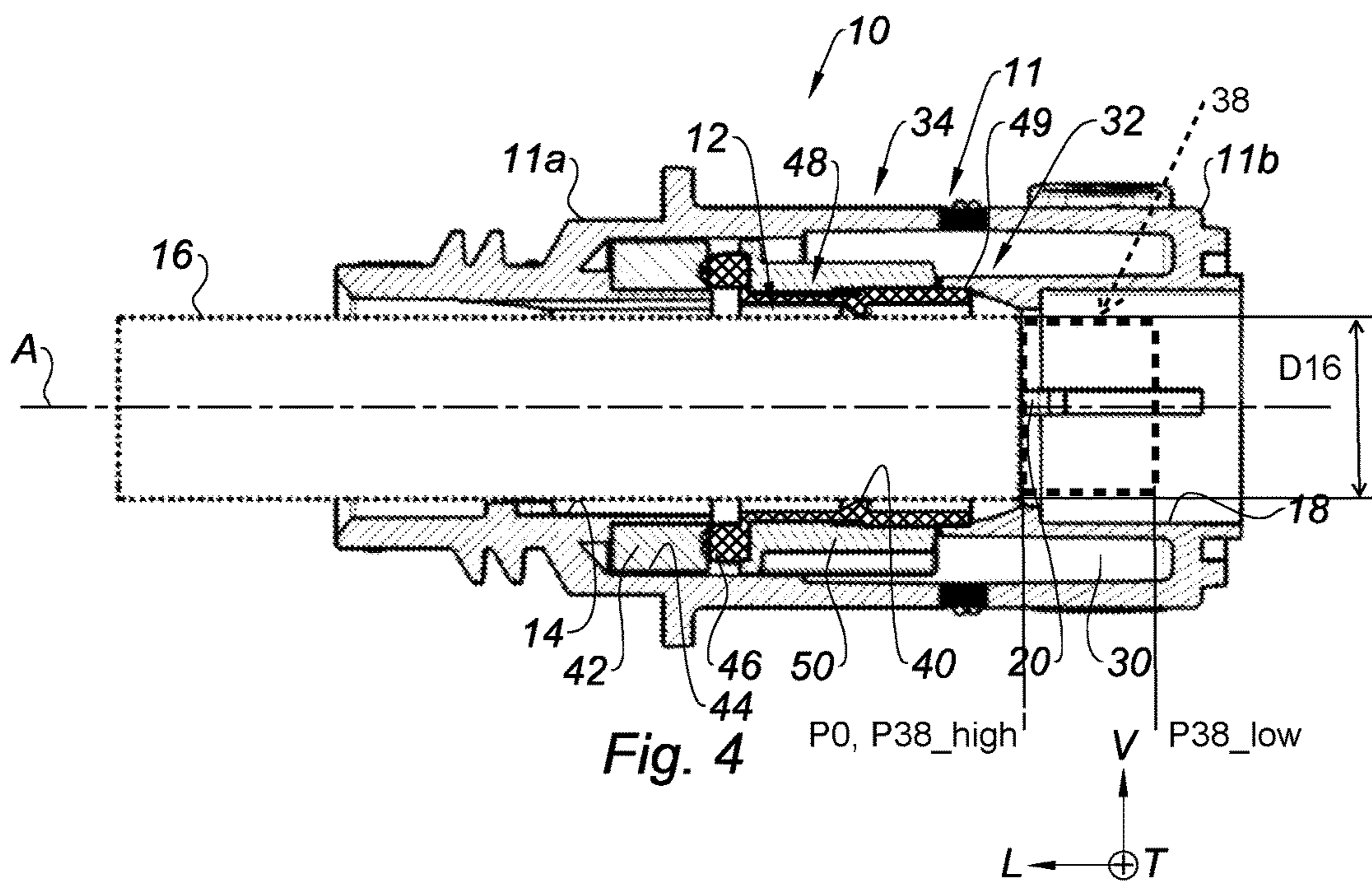


Fig. 4

FILLING HEAD FOR FILLING A TANK WITH A LIQUID

The invention concerns a filling head for filling a tank with a liquid, and more particularly for filling a tank belonging to a device for depollution by selective catalytic reduction for a motor vehicle.

A device for depollution by selective catalytic reduction, also known by the acronym «SCR», is a technology currently used for the depollution of nitrogen oxides NO_x, on vehicles with a heat engine such as a Diesel engine.

This type of device generally includes at least one tank for storing a liquid additive product containing urea, a head for filling the tank, a catalyst with an injector, a metering module, and a control and driving device.

The user of the vehicle equipped with such a depollution device should be able to carry out the filling of the tank by himself, in a service station for example.

To this end, the filling head, generally tubular-shaped, is arranged so as to be accessible from the outside of the vehicle, upstream of the tank.

The filling head includes a conduit for filling the tank which extends axially along a filling axis from an upstream section which is adapted to receive the filling nozzle, up to a downstream section which is designed to be connected to the tank to fill via a conduit.

This type of filling head is generally associated with a degassing circuit which promotes the evacuation of the gases which are expelled by the liquid during the filling of the tank.

In general, the degassing circuit includes an inlet which is in communication with the tank, and an outlet which is in communication with the outside of the depollution device and which allows discharging the gases into the atmosphere.

Such a filling head is described and represented in the document EP-A1-2719567, for example.

In order to fill the tank, the filling nozzle is introduced in the filling conduit of the filling head, the user actuates the nozzle which spills out a liquid jet through the filling head until the tank is full and starts flowing back the liquid.

In order to prevent a backflow of liquid outside of the vehicle, the nozzle is generally equipped with a device for automatically shutting off the jet.

Nonetheless, at use, a backflow and a sputtering of liquid are sometimes observed despite the presence of the device for automatically shutting off the jet, in particular depending on the angle of inclination of the nozzle in the filling head.

Also, the user should be able to benefit from several automatic nozzle shut-offs at the end of filling without any risk of fluid discharge to the outside. As example, some manufacturers require enabling three automatic shut-offs without any risk of discharges in order to fill the tank to its maximum level.

In addition, the filling heads according to the prior art do not allow a sufficient filling rate. By sufficient filling rate is meant a rate close to 40 liters per minute. This rate of 40 liters per minute would allow a time saving for the car manufacturer during the assembly of the vehicle. The rate of 40 liters per minute would also have the advantage of allowing the motorist customer to fill his tank, in a service station, indifferently with pumps provided for light vehicles or pumps provided for heavy-goods vehicles, since not all service stations are equipped with specific pumps, with a low rate, for light vehicles.

The present invention aims in particular to solve these drawbacks and, to do so, relates to a filling head for filling a tank with a liquid, the filling head delimiting:

a conduit for filling the tank which extends axially along a filling axis from an upstream section which is adapted to receive a filling nozzle, up to a downstream section which is designed to be connected on the tank to fill, and

a degassing circuit including an inlet which is adapted to be connected on the tank and an outlet in communication with the outside, the filling head being characterized in that it delimits a suction window which connects the downstream section of the filling conduit to the degassing circuit, so as to promote the suction of the gases via the degassing circuit, during the filling of the tank.

More particularly, the invention concerns a filling head for filling a tank with a liquid, the filling head delimiting:

a conduit for filling the tank which extends axially along a filling axis (A) from an upstream section which is adapted to receive a filling nozzle, up to a downstream section which is designed to be connected on the tank to fill,

an annular sealing collar which extends around the filling axis (A) and which is designed to form an annular lip seal which conforms to the peripheral face of the nozzle, and

a degassing circuit including an inlet which is adapted to be connected on the tank and an outlet in communication with the outside, as well as a filling chamber which is interposed between the inlet and the outlet and in communication with these latter, said outlet being formed by a degassing window located upstream with respect to the sealing collar and arranged so as to allow the gases to escape from the chamber to the outside,

the filling head being characterized in that it delimits, downstream of the sealing collar, at least one suction window which connects the chamber of the degassing circuit to the downstream section of the filling conduit, and which is arranged at the outlet of the nozzle, so as to promote the suction via the degassing circuit of the gases which escape from the tank, during the filling of the tank.

The suction window allows depressurizing the degassing circuit, which promotes the escape of the gases during the filling of the tank and avoids inadvertent cut-offs during the filling phase which are related to insufficient degassing and flow.

Indeed, the liquid flow which is injected by the nozzle generates, by its flow speed, a depression in the downstream section of the filling conduit of the filling head. The suction window sets the downstream section and the degassing circuit in communication with each other, which allows depressurizing the degassing circuit so as to promote the degassing.

It is observed that the absence of this window leads to rises of liquid, so that the nozzle is frequently triggered and the filling time then significantly increases.

According to another feature of the invention, the filling head delimits a filling chamber which communicates with the suction window and which is adapted to be filled with repelled liquid.

The chamber allows delaying the backflow of liquid by being filled, which leaves more time for the automatic nozzle turning-off device to be triggered.

According to another feature of the invention, the filling chamber is in communication with the inlet and the outlet of the degassing circuit of the filling head.

In other words, the chamber belongs to the degassing circuit. The chamber has thus a dual function.

According to another feature of the invention, the upstream section of the filling conduit delimits a degassing window which forms the outlet of the degassing circuit.

This degassing window opens into the upstream section of the filling conduit so as to allow the gases to circulate through the degassing circuit, to the outside at atmospheric pressure.

According to another feature of the invention, the filling conduit is equipped with an annular sealing collar which extends around the filling axis and which is designed to cooperate with a filling nozzle.

The collar is designed to avoid any direct rise of fluid to the outside during the filling phase and after several triggers of the nozzle. Thus, the risks of sputtering and discharge are avoided.

Advantageously, the collar is located upstream of the area of detection of liquid by the nozzle.

According to another feature of the invention, the filling head is equipped with a permanent magnet which is inserted in a recess of the upstream section of the filling conduit and which is adapted to act on a device for automatically turning off the filling nozzle.

According to another feature of the invention, the filling head includes at least one retaining finger which bears axially on the magnet so as to retain the magnet in its recess.

The retaining finger blocks the magnet in position and prevents it from vibrating.

According to another feature of the invention, the filling head includes a sealing ring which is elastically-deformable and which forms the degassing window, the sealing collar and the retaining stud, into one piece.

According to another feature of the invention, the filling head includes a stop which projects radially in the filling conduit so as to limit the axial stroke of the filling nozzle.

The invention also concerns a device for depollution by catalytic reduction including a filling head of the previously described type.

Other features and advantages of the invention will appear upon reading the following detailed description for an understanding of which reference will be made to the appended drawings in which:

FIG. 1 is an exploded perspective view, which illustrates a filling head according to the invention;

FIG. 2 is a cutaway perspective view, which illustrates the filling head of FIG. 1 delimiting in particular the suction window, the filling chamber and the degassing window;

FIG. 3 is a cutaway perspective view, which illustrates the direction of circulation of the filling liquid and of the exhaust gases through the filling head according to the invention;

FIG. 4 is a longitudinal sectional view, which illustrates the arrangement of a filling nozzle in the filling head.

It should be noted that, in the present patent application, the terms «upstream» and «downstream» should be understood with respect to the circulation of the liquid during filling through the filling head, that is to say from the left to the right according to FIG. 2.

In addition, in order to clarify the description and the claims, the terms longitudinal, vertical and transverse will be adopted without limitation with reference to the three dimensional axes L, V, T indicated in the figures, whose axis L is parallel to the axis of the filling head.

In FIG. 1 is represented a filling head 10 for filling a tank 60 with a liquid, more particularly an additive liquid containing urea.

The filling head 10 is designed to be integrated to a device for depollution by selective catalytic reduction (not represented).

The filling head is essentially constituted by a body 11 which is made into two portions 11a, 11b.

As can be seen in FIG. 4, the filling head 10 delimits an inner filling conduit 12 which extends axially along a longitudinal filling axis A, from an upstream section 14 which is adapted to receive a filling nozzle 16, up to a downstream section 18 which is designed to be connected on the tank to fill.

For this purpose, the downstream section 18 of the filling conduit 12 is connected to the tank 60 via a connecting tubing 19 shown in FIG. 3.

The upstream section 14 of the filling conduit 12 extends up to a stop 20 which projects radially in the filling conduit 12 to limit the axial stroke of the filling nozzle 16.

Also, the filling head 10 delimits a degassing circuit which allows the evacuation of the gases expelled by the liquid during the filling of the tank 60.

To this end, the degassing circuit includes an inlet 22 which is adapted to be connected to the tank 60 and an outlet 24 which is in communication with the outside at atmospheric pressure.

As seen in FIG. 3, the inlet 22 of the degassing circuit is constituted by a connector 26 which is connected to an upper portion of the tank 60 by a flexible hose 28, in order to allow the gases present in the tank to escape during the filling.

The degassing circuit also comprises a filling chamber 30 which is interposed between the inlet 22 and the outlet 24 and which is in communication with the inlet 22 and the outlet 24 of the degassing circuit.

Referring to FIGS. 3 and 4, the filling chamber 30 is formed by a generally annular cavity which extends around the filling conduit 12 and which is delimited by an inner wall 32 and an outer wall 34 of the body 11 of the filling head 10.

Preferably, as shown in FIGS. 1 to 4, the filling chamber 30 formed by an annular cavity is delimited by an annular inner wall 32 which (laterally) separates said annular chamber 30 from said conduit 12 and throughout the (radial) thickness of which the suction window 38 is pierced.

Advantageously, the suction window 38 may thus be disposed substantially tangent to the filling conduit 12, and therefore substantially tangent to the liquid jet, which promotes the suction.

In addition, the upstream section 14 of the filling conduit 12 delimits a degassing window 36 which forms the outlet 24 of the degassing circuit.

The degassing window 36, shown in particular in FIGS. 2 and 3, is formed in the inner wall 32, facing the nozzle 16, and allows the exhaust gases to escape from the chamber 30 to the outside at atmospheric pressure.

The arrows F1 shown in FIG. 3 illustrate the circulation of the exhaust gases.

According to another aspect of the invention, the filling head 10 delimits a suction window 38 which connects the downstream section 18 of the filling conduit on the degassing circuit so as to promote the suction of the gases via the degassing circuit during the filling of the tank.

As seen in FIG. 3, the suction window 38 opens into the filling chamber 30 which belongs to the degassing circuit.

Thus, during the filling of the tank by the nozzle 16, the flow of liquid which flows from the free end of the nozzle 16 causes, by its flow velocity, a depression in the chamber 30, this depression promoting the suction of the gases contained in the tank.

Consequently, by promoting the circulation of the exhaust gases through the exhaust circuit, the suction window 38 allows increasing the filling rate of the tank.

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Advantageously, in order to promote the suction of the exhaust gases, the suction window **38** is arranged directly at the outlet of the nozzle **16**, that is to say directly downstream of the stop **20** which limits the stroke of the nozzle **16**.

Indeed, such a positioning of the suction window **38** immediately downstream of the nozzle allows taking benefit of a minimum flow section, that is to say a minimum diameter of the liquid jet injected by the nozzle **16**, and consequently a maximum liquid speed, and therefore the best possible suction by Venturi effect.

Furthermore, the axial height of the suction window **38**, according to which said suction window **38** extends, along the axis A of the filling head **10**, downstream of the end of the nozzle **16**, will be sufficiently restricted to avoid that, because of the divergence angle (opening angle) of the liquid jet, liquid is directly projected by the nozzle **16** in said suction window **38**, which would reduce the suction performances.

As such, as illustrated in FIG. 4, it will be noted that the distance which separates axially, along the axis A, a reference position P0 which corresponds to the downstream end of the nozzle **16**, and therefore to the stop **20**, from the downstream opening limit of the suction window **38** (that is to say from the lower limit of said suction window **38**) P38_low, said downstream opening limit P38_low being located downstream of said reference position P0, is preferably smaller than or equal to 130%, and even smaller than or equal to 110% of the inner diameter D16 of the nozzle **16**, that is to say of the minimum diameter of the liquid jet.

Similarly, the upstream limit P38_high of the suction window **38** will be preferably located, in abscissa along the axis A, within a range of positions comprised between 20% of the inner diameter D16 of the nozzle, upstream of the reference position P0, and 30% of the diameter D16 downstream of the reference position P0.

Preferably, said upstream limit P38_high of the suction window P38 will axially coincide with the reference position P0, or will be placed slightly downstream of the reference position P0, for example at a distance from the reference position P0 comprised between 15% and 25%, and even between 20% and 25% of the inner diameter D16 of the nozzle.

As an indication, and in particular for an inner diameter D16 of the nozzle **16** comprised between 15 mm and 20 mm, and more particularly equal to 16 mm, if we consider, as a reference position P0 along the axis A, the upstream abscissa of the stop **20** and therefore the abscissa of the downstream end of the nozzle **16** corresponding to the abscissa of emission of the liquid jet in the filling conduit **12**, then the suction window **38** will extend:

from an upstream limit P38_high which is preferably comprised between 5 mm, and even 3 mm, upstream of the reference position P0 and 5 mm downstream of said reference position P0, and for example, preferably between 3 mm and 4 mm downstream of the reference position P0, and more particularly at 3.5 mm (namely about 22% of 16 mm), downstream of the reference position P0,

and/or, according to a preferred feature which may constitute an invention on its own, up to a downstream limit P38_low comprised between 15 mm and 25 mm, and preferably between 15 mm and 20 mm, and for example at about 17.5 mm (namely about 110% of 16 mm), downstream of the reference position P0.

According to a preferred embodiment, the suction window **38** has a surface area in the order of 220 square millimeters, for example with an axial height of 13 millimeters along the axis A of the filling head **10**, and a width

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of 17 millimeters. It should be noted that the shape of the suction window **38** may be other than that of the represented rectangular, for example a rather triangular, trapezoidal, circular, or oval shape. Similarly, the suction window **38** may be constituted by several openings, so as to deliver the most adapted suction.

It will be noted that the positioning and sizing features of the suction window **38** may constitute an invention on its own, and be implemented in any filling head **10** intended to receive a filling nozzle **16** in a determined docking position, preferably against a stop **20**, and this regardless, amongst others, of the presence or absence of a sealing collar **40**, and/or regardless of the existence or absence of a degassing window **36** which is distinct from said suction window **38** (although the presence of such a degassing window **36**, distinct from and complementary with the suction window **38**, is nevertheless preferred).

The suction window **38** also allows the passage of the filling liquid from the filling conduit **12**, up to the filling chamber **30**, in case of a rise of fluid by the tubing **19**.

Indeed, the filling chamber **30** is adapted to be filled with liquid repelled from the tubing **19** at the end of tank filling.

Thus, when the tank is full, the liquid is repelled up to the filling head **10** via the tubing **19**, and then the liquid penetrates in the filling chamber **30**.

This feature allows delaying and limiting the rise of liquid toward the upstream section **14** of the filling conduit **12**.

More particularly, this arrangement consisting in providing that at least a portion of the filling chamber **30** as well as the suction window **38** are located downstream of the stop **20**, and therefore downstream of the end of the nozzle **16**, allows the liquid overflow which rises via the tubing **19** to spill out first in the filling chamber **30**, through the suction window **38**, before said repelled liquid reaches the nozzle **16**, which stabilizes the rise of the liquid and avoids the risks of sputtering.

It will also be noted that the use of the suction window **38** and of the filling chamber **30** as a spillway of a rising liquid overflow may also be implemented, alternatively, within a filling head devoid of a sealing collar **40** as described hereinafter.

It will also be noted that the liquid can penetrate in the degassing circuit beyond the chamber **30**, for example up to the inlet **22** of the degassing circuit.

In addition, the filling conduit **12** is equipped with an annular sealing collar **40** which extends around the filling axis A and which is designed to cooperate with the filling nozzle **16**.

As seen in FIG. 4, the collar **40** forms an annular lip seal which conforms to the peripheral face of the nozzle **16** to prevent the liquid from rising up via the upstream section **14** of the filling conduit **12**.

Hence, the liquid cannot rise up directly via the filling conduit **12**, and has therefore to follow the preferred circuit by passing through the suction window **38** and the chamber **30**.

This feature allows slowing the rise of the liquid while maintaining the degassing function for even longer.

Several cut-offs of the nozzle are therefore possible without any risk of liquid discharge.

It will also be noted that the use of a suction window **38** and a degassing window **36** distinct from each other, and each axially located on a different side (respectively on the downstream side and on the upstream side) of the sealing collar **40**, advantageously allows optimizing each of the respective suction and degassing functions.

In particular, such an arrangement allows making each of these functions immediately available from the very beginning of filling, while conferring optimum performances to said function, and maintaining each of said functions operational as long as possible during filling.

In a non-limiting manner, it is possible to add baffles in the chamber **30** in order to slow down the stroke of the liquid even further.

Also, the filling head **10** is equipped with a permanent magnet **42** which is inserted in a recess **44** of the upstream section **14** of the filling conduit **12** and which is adapted to act on a device (not represented) for automatically turning off the filling nozzle **16**.

The recess **44** has an annular shape, complementary to the shape of the magnet **42**, which extends around the filling axis A, the recess being open axially toward the downstream section **18** so as to allow the insertion of the magnet **42** during mounting of the filling head **10**.

In a complementary manner, the filling head **10** includes a plurality of retaining fingers **46** which are distributed around the filling axis A and which extend axially from a sealing ring **48**, toward the magnet **42**. Each retaining finger **46** bears axially on the magnet **42** so as to retain the magnet **42** in its recess **44**.

According to another aspect, referring to FIG. 4, the sealing ring **48** has a cylindrical-shaped downstream free end **49** which cooperates with a complementary sleeve formed by the body **11** of the filling head, so as to limit the penetration of liquid from the downstream section **18** of the filling conduit **12**, up to the degassing circuit.

Referring to FIG. 2, the sealing ring **48** forms the degassing window **36**, the sealing collar **40** and the retaining fingers **46**, in one piece.

The ring **48** is made of an elastically-deformable material, preferably of elastomer, for example of ethylene-propylene-diene monomer.

This feature allows the collar **40** to be elastically deformed so as to guarantee sealing around the nozzle **16**, and also allows the retaining fingers **46** to damp the magnet **42** in order to prevent it from vibrating.

As seen in FIGS. 1 and 4, the ring **48** is arranged in a tubular guide **50** which is mounted in the body **11** of the filling head **10** along the filling axis A.

It will be noted that the chamber **30** is partially delimited by the guide **50** and that the guide **50** also delimits the degassing window **36**.

As such, it will be noted that, according to a preferred variant, the degassing window **36** is not formed in the deformable ring **48**, but is rather arranged in the tubular guide **50**.

Alternatively, the ring **48** may be made by overmolding over the tubular guide **50**.

In this case, the ring **48** may be made of an elastomer (rubber), such as EPDM, or further, and preferably, of a vulcanized thermoplastic material, for example a PP/EPDM mixture, which has in particular the advantage of effectively adhering to the tubular guide **50**, in particular when said guide **50** is made of polypropylene (PP), whether filled or not with reinforcing fibers.

Furthermore, the aforementioned vulcanized thermoplastic materials have the advantage of being compatible with the aqueous urea solutions, and besides have injection cycle time durations shorter than the cycle time durations required for rubbers.

According to a non-represented variant, the sealing ring **48** forms a rim which is adapted to obstruct the recess **44** of the magnet **42** in order to prevent the liquid from penetrating in the recess **44**.

The present description of the invention is given as a non-limiting example.

In particular, said invention also covers as such a method for using, within a filling head **10** according to any one of the variants of the invention and connected to a tank, a liquid flow injected in the filling conduit **12** of said head **10** by a filling nozzle **16** to generate, thanks to the flow speed of said liquid, a depression in the degassing circuit, through a suction window **38** that is arranged in the wall of the filling conduit **12** directly at the outlet of said nozzle **16**, so as to promote the suction via the degassing circuit of the gases escaping from the tank **60**.

The invention claimed is:

1. A filling head for filling a tank with a liquid, the filling head delimiting:

a conduit for filling the tank which extends axially along a filling axis from an upstream section which is adapted to receive a filling nozzle, up to a downstream section which is designed to be connected on the tank to fill, an annular sealing collar which extends around the filling axis and which is designed to form an annular lip seal which conforms to the peripheral face of the nozzle, and

a degassing circuit including an inlet which is adapted to be connected on the tank and an outlet in communication with the outside, as well as a filling chamber which is interposed between the inlet and the outlet and in communication with these latter, said outlet being formed by a degassing window located upstream with respect to the sealing collar and arranged so as to allow the gases to escape from the chamber to the outside, the filling head wherein it delimits, downstream of the sealing collar, at least one suction window which connects the chamber of the degassing circuit to the downstream section of the filling conduit, and which is arranged at the outlet of the nozzle, so as to promote the suction via the degassing circuit of the gases which escape from the tank, during the filling of the tank.

2. The filling head according to claim 1, wherein it includes a stop which projects radially in the filling conduit so as to limit the axial course of the filling nozzle and in that the suction window is arranged directly downstream of said stop.

3. The filling head according to claim 1, wherein the filling chamber communicates with the downstream conduit section through the suction window so as to enable the filling of said filling chamber with liquid repelled from the filling conduit.

4. The filling head according to claim 1, wherein the upstream section of the filling conduit delimits at least one degassing window which forms the outlet of the degassing circuit.

5. The filling head according to claim 4, wherein it includes:

at least one retaining finger which bears axially on the magnet so as to retain the magnet in its recess, and a sealing ring which is elastically-deformable and which forms the degassing window, the sealing collar and the retaining finger, in one piece.

6. The filling head according to claim 1, wherein the filling chamber is formed by an annular cavity which extends around the filling conduit and which is delimited by

an annular inner wall which separates it from said conduit and throughout the thickness of which the suction window is pierced.

7. The filling head according to claim 1, wherein it is equipped with a permanent magnet which is inserted in a recess of the upstream section of the filling conduit and which is adapted to act on a device for automatically turning off the filling nozzle.

8. The filling head according to claim 7, wherein it includes at least one retaining finger which bears axially on the magnet so as to retain the magnet in its recess.

9. The filling head according to claim 1, wherein the distance which separates axially, along the axis, a reference position, corresponding to the downstream end of the nozzle, from a downstream opening limit of the suction window, said downstream opening limit being located downstream of said reference position, is smaller than or equal to 130% of the inner diameter of the nozzle.

10. Using, within a filling head according to claim 1 connected to a tank, a liquid flow injected in the filling conduit of said head by a filling nozzle to generate, thanks to the flow speed of said liquid, a depression in the degassing circuit, through a suction window that is arranged in the wall of the filling conduit directly at the outlet of said nozzle, so as to promote the suction via the degassing circuit of the gases escaping from the tank.

11. A device for depollution by selective catalytic reduction for a motor vehicle or heavy-goods vehicle including a filling head according to claim 1.

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